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Environmental Health Section

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March 1, 2002

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DICK
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AMY

Kevin has the diskette

Richard R. Long, Director
Air and Radiation Program
U.S. EPA - Region VIII
One Denver Place
999 18th Street, Suite 300
Denver, CO 80202-2466

Dear Mr. Long:

During recent meetings with you and your staff, we indicated that the North Dakota Department of Health has been developing an SO_2 emissions inventory of baseline oil and gas wells in the vicinity of North Dakota PSD Class I areas. The intent is to include this inventory in Calpuff modeling for PSD Class I increments. During our meetings, it was agreed that the oil and gas emissions may have a major impact on any PSD increment assessment. We further indicated we would provide your offices with our assessment of the oil and gas impact thus far.

Enclosed is a memorandum describing the Department's development of the baseline emissions inventory for oil and gas wells that relies on results of the Williston Basin Study performed in 1987-88. Also enclosed on computer diskette is the initial iteration of the baseline inventory, as well as the Department's Year 2000 inventory of oil and gas well SO_2 emissions. The inventories on the diskette are provided as Calpuff-ready input files, with separate files for each Class I area.

Initial modeling with the baseline inventory of oil and gas wells suggests that its modeled impact at some Class I receptors may more than offset modeled impact of the Year 2000 oil and gas inventory (net increment expansion). Therefore, the Department believes it is important to account for the net impact of oil and gas well emissions in Calpuff Class I modeling. We recognize there may be other methodologies to address the full extent of the oil and gas emissions. As the attached memorandum explains, the Williston Basin Study was used because it was readily available but the Department is continuing to evaluate other methods of assessing oil and gas emissions.

Also during our recent meetings it was indicated that Calpuff was expected to be approved in the near future. Could you provide us an update on that issue. Also will the approval process address any technical concerns that may have been an issue.

If you have any questions regarding the enclosed material, please contact Rob White of my staff.

Sincerely,

Terry O'Clair

Terry L. O'Clair, P.E.
Director
Division of Air Quality

TLO:saj
Enc:

SFN 8094

NORTH DAKOTA DEPARTMENT OF HEALTH

INTRADEPARTMENTAL MEMORANDUM

MEMO TO : Terry L. O'Clair, P.E.
Director
Division of Air Quality

FROM : Robert J. White RJW
Meteorologist
Air Quality Impact Analysis
Division of Air Quality

RE : Modeling Net PSD Class I Increment
Consumption from Oil and Gas Wells
Including Baseline Emissions

DATE : March 1, 2002

The North Dakota Department of Health (NDDH) has been modeling SO_2 impacts from oil and gas wells since at least 1989-1990 when the Williston Basin Regional Air Quality Study (WBS, 1990) was performed. The Williston Basin Study processed oil and gas H_2S and production data for all North Dakota wells operating during the period November 1987-March 1988. Modeled SO_2 concentrations were evaluated against the State and Federal Ambient Air Quality Standards (AAQS) and Class II and Class I PSD increments. Only increment-consuming wells were modeled to address PSD increment, by considering only wells with the earliest completion date after the minor-source baseline date to consume increment. The NDDH examined impacts at or near 12 worst-case oil and gas fields, all four North Dakota Class I areas, and two Class I areas in extreme eastern Montana. The standard procedure for minor SO_2 sources was to model all minor sources (including oil and gas sources) out to 50 km from each North Dakota Class I area. Programs were written and executed to calculate SO_2 emission rates and exit velocities for all oil and gas wells producing gas during November 1987-March 1988, extract only data for wells within 50 km of each North Dakota Class I area, and output the oil and gas well source data in a format ready to input to an air quality model.

Only monthly totals of well production data are available from the North Dakota Industrial Commission's Oil and Gas Division. Consequently, NDDH modeling studies of oil and gas SO_2 impacts can characterize averaging periods no shorter than one month; variations in emissions on a scale of 1 to 24 hours are not available to address peak short-term impacts. The NDDH generally has used the 5-month-average SO_2 emission rates for oil and gas wells since the WBS. Such emissions would be approximately representative of monthly to annual average emissions for oil and gas wells.

The NDDH recently performed an analysis of oil and gas sources' SO_2 increment consumption on Class I areas for the same five months of the year 2000. The procedure used was essentially the same as that used in the Williston Basin Study, except that additional Class I receptors developed for the Minnkota analysis (1999) were also included. Potential increment expansion due to baseline wells was not modeled then, consistent with past practice. The Department never attempted to model Class I increment expansion or consumption due to changes in emissions from baseline oil and gas wells because the Department understood there was little if any reliable data on oil and gas wells from 1976-77. The current needs to refine our Class I increment modeling have motivated us to reevaluate what, if anything, could be done to account for increment consumption or expansion from baseline oil and gas wells.

A few months ago our division obtained from the Oil and Gas Division all available computer data on wells producing during the 1976-77 period, the two years before the minor-source baseline date, December 19, 1977. There were some additional H_2S data, but it still looked somewhat incomplete. There was almost no data on gas volumes flared or used in treaters. Lease-use and flaring volumes were available only for the Little Knife Field and some wells in Elkhorn Ranch Field. There were some data on total gas production, but little more than 300 wells had nonzero gas production out of about 1800 wells, a small fraction, which seems rather incomplete. More likely, many of the total gas volume data that are zero really represent missing data. The Oil and Gas Division recently stated that many operators at that time did not consistently report gas production because oil was the main product and gas often was considered to be a waste product to be flared. Based on input from the Oil and Gas Division, many of the 300 wells with nonzero gas production probably were reporting gas sold not flared, but there are indications that some of the rest of the wells also sold gas too.

There is no way of reliably determining from the 1976-77 data which wells were selling gas and which were flaring gas. Therefore, the amount of gas combusted onsite is uncertain for many wells. In addition, recently the Oil and Gas Division indicated that gas production data before about 1987 were not very reliable. Because of the lesser status of gas, it was not consistently reported or quality checked until about the mid-1980s. For all of the above reasons, it was concluded that we cannot use the 1976-77 gas production data alone to estimate oil and gas well baseline emissions. Rather than attempting to do another analysis of oil and gas emissions for years before 1987 using somewhat incomplete or unreliable data, we used the WBS 1987-88 data, which were more reliable and already processed and available, as a surrogate for estimating oil and gas well SO_2 emissions from 1976-77.

The procedure for using the WBS data to estimate baseline oil and gas well emissions was executed as follows. The well file numbers and locations of all wells producing during 1976-77 were extracted from the master oil and gas data file. Only wells that actually existed and were producing during 1976-77 were processed by building a new inventory of 1976-77 wells using the file numbers and locations of the 1976-77 wells as a starting point. Emission rates (and heats of combustion) for wells that existed in both 1987 (WBS period) and 1977 (baseline date) were copied over from the WBS inventory file to the new inventory file more or less as is. For wells that produced in 1977 but not in 1987, so no data were directly available, the average emission rate over all wells in the same field from the WBS was substituted into the new inventory for each such well, where available. Whenever data were needed for a 1977 well in a field that did not produce at all during 1987-88, then a corresponding field-average emission rate from a nearby field producing from the same pool was substituted into the new inventory.

The problem with using the WBS data "as is" is that much of the gas produced during 1987-88 was sold to gas plants and not flared, whereas most of these gas plants didn't exist in 1976-77, so all of that sold gas would have to have been flared in 1977. Thus, the flare SO_2 emission rates from 1987-88 (WBS) could often be much lower than what would be appropriate for 1976-77 emissions because of the volume of sold gas. Therefore, the procedure executed was to calculate the sum of the 1987-88 flared gas and sold gas (equal to total gas production minus lease-use gas volume), compute a flare emission rate based on this sum, and use it to estimate flare emission rates for the 1976-77 sources wherever a gas-gathering system was operating in 1987-88 but not in 1976-77.

This situation applied to sources near the Theodore Roosevelt National Park (TRNP) South Unit, Elkhorn Ranch Unit, and many of the sources near the North Unit. The opposite situation applied farther north near Lostwood Wilderness Area due to operation of Tioga Gas Plant and Lignite Gas Plant, which were operating in 1977 and 1987. The NDDH obtained maps of the gas gathering systems, currently owned by Amerada Hess and Bear Paw, which show the region over which most gas produced would have been sold, not flared. The maps reflect operations in the mid to late 1990s, but give some indication of the extent of the systems in 1977. Tioga's gas gathering system reaches from near the Canadian border 20 miles north of Tioga southward to southeastern McKenzie County, less than 50 km northeast of the North Unit. Tioga's system collects gas from at least 20 oil and gas fields. Lignite's gas-gathering system collects gas from approximately nine fields in Burke County, including most wells north of Lostwood Wilderness Area. In addition, two small gas plants, the Red Wing Creek Gas Plant and Boxcar Butte Gas Plant, just west of the North Unit in western McKenzie County, operated in 1977 and received gas from only two isolated fields. The flare SO_2 emission rates from wells connected to these gas-gathering systems in 1977 were copied as is directly from the WBS inventory file to the new inventory file, because most of the gas produced was sold to the gas plants rather than flared, both in 1987 (WBS period) and in 1977. Treater emissions would not necessarily be affected by the amount of sold gas, so treater emissions were copied over from the WBS inventory as is.

The new inventory of estimated baseline emissions from oil and gas wells was produced as described above. Similar to the standard procedure followed for current oil and gas wells (since the WBS), data for all wells with emissions within 50 km of each North Dakota Class I area were extracted from the inventory file and output in Calpuff-ready format. The impact of these sources was modeled using Calpuff at the standard Class I receptor locations and the hourly predictions were stored in a Calpuff binary output file. Current impacts from all oil and gas wells based on five months of well production data in 2000 were modeled using a similar procedure a few months ago. A year 2000 inventory of oil and gas well emissions was produced, data for all emitting wells within 50 km of any North Dakota Class I area were extracted, and source input data were output for these wells in Calpuff-ready format. The year 2000 oil and gas sources were modeled using Calpuff at the standard Class I receptors and the hourly predictions were stored in a Calpuff binary output file. Finally, both files were processed in the Earth Tech program Calsum, by subtracting the estimated baseline concentration at each receptor for each hour in the first run from the year 2000 concentration at each receptor and each hour for an entire year, and the results were summarized using Calpost. Calpuff predictions were postprocessed into 3-hour and 24-hour averages and highest, second-highest values and exceedances were noted. Model results are not reported here, because the baseline emissions inventory is considered preliminary and undergoing further review.

This procedure therefore accounted for impacts from PSD-increment-consuming sources' emissions in 2000 (as before), increment expansion from baseline wells that no longer operate, and the net increment consumption or expansion from the change in impact from baseline sources between 1977 and 2000. Only the PSD-increment-consuming emissions were modeled previously. This procedure should reduce increment consumption where baseline wells have reduced emissions since 1977, but could potentially increase increment consumption wherever baseline wells have increased emissions since 1977. The latter situation could occur if a baseline well was recompleted into a more sour pool (higher H_2S) or if the well began producing from a formation containing a higher proportion of gas.

RJW:saj